



Indoor Air Quality: Knowledge Base and Gaps

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What Do We Know About Indoor Air Quality?

- Many sources of indoor air pollution
 - Building materials, products, human activities, outdoor air
- All building types affected
 - Residences, offices, schools
- Variety of health effects from indoor air pollution
 - Lung cancer, asthma, irritation effects, neurotoxic effects



What Do We Know About Indoor Air Quality?

- Exposures from pollutants indoors are high
 - Pollutant concentrations indoors are often 2-5 times higher than outdoor pollutant concentrations
 - People spend up to 90% of their time indoors
- Risks from indoor air pollution are high
 - Radon risk assessment from BEIR VI (NAS)
 - ETS risk assessment (ORD)
 - Risks from other pollutants also believed significant (for example, Air Toxics, Mold)

What Do We Know About Indoor Air Quality?

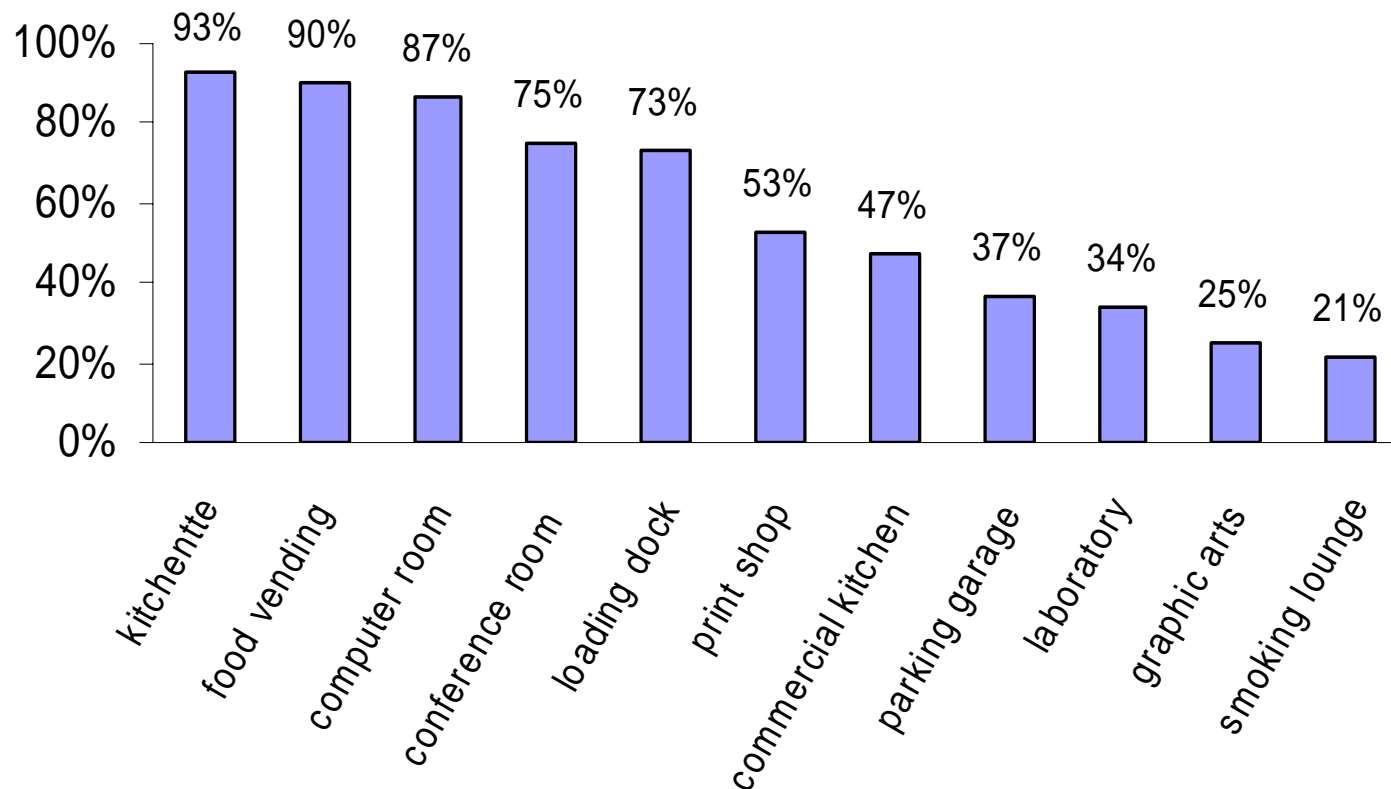


Basic principles for managing indoor air quality

- Source control (removing, substituting or modifying source)
- Ventilation (both general ventilation and spot ventilation)
- Air cleaning

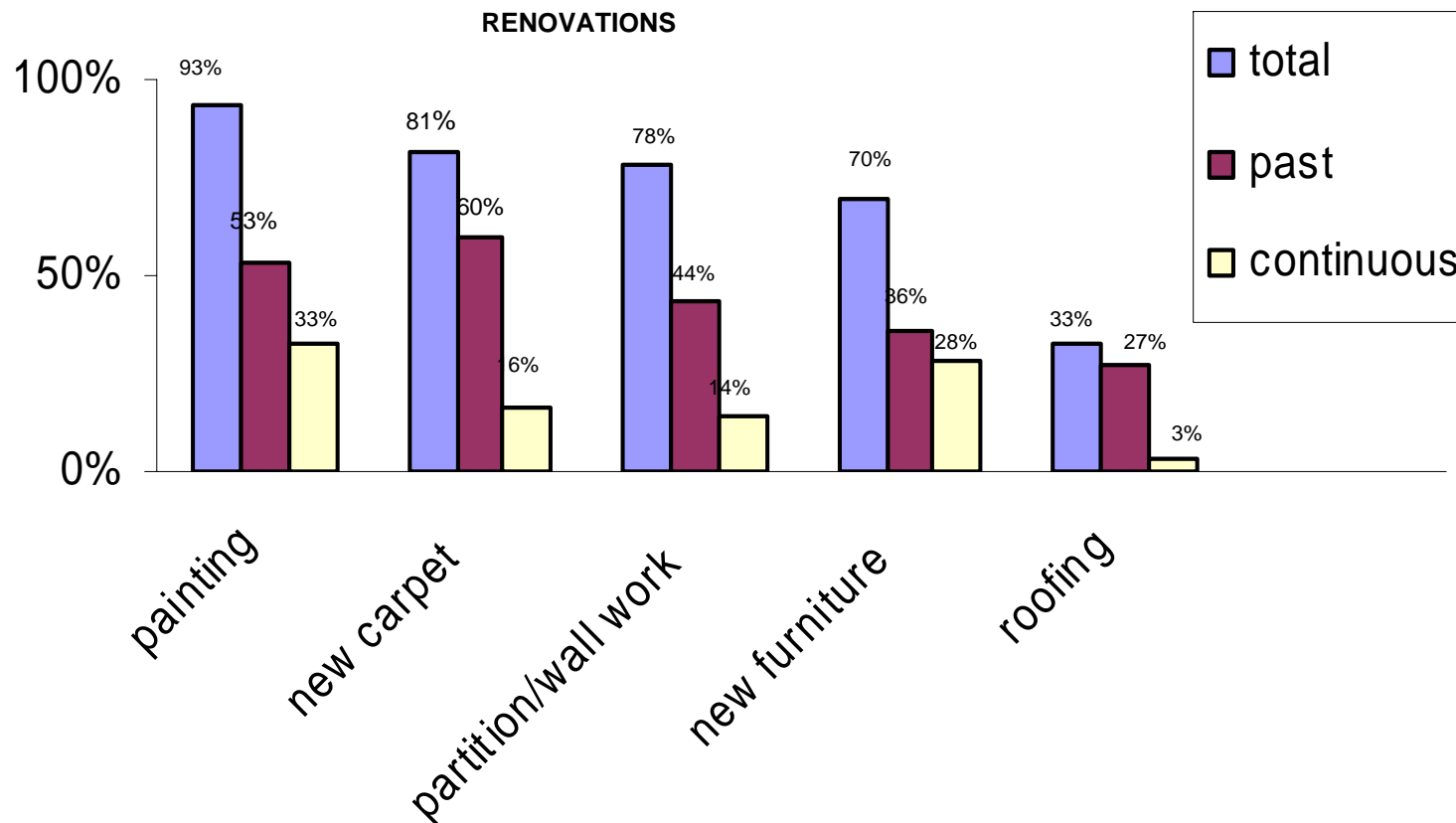
What Do We Know About Indoor Air Quality?

Potential Indoor Pollutant Sources: Special Use Areas



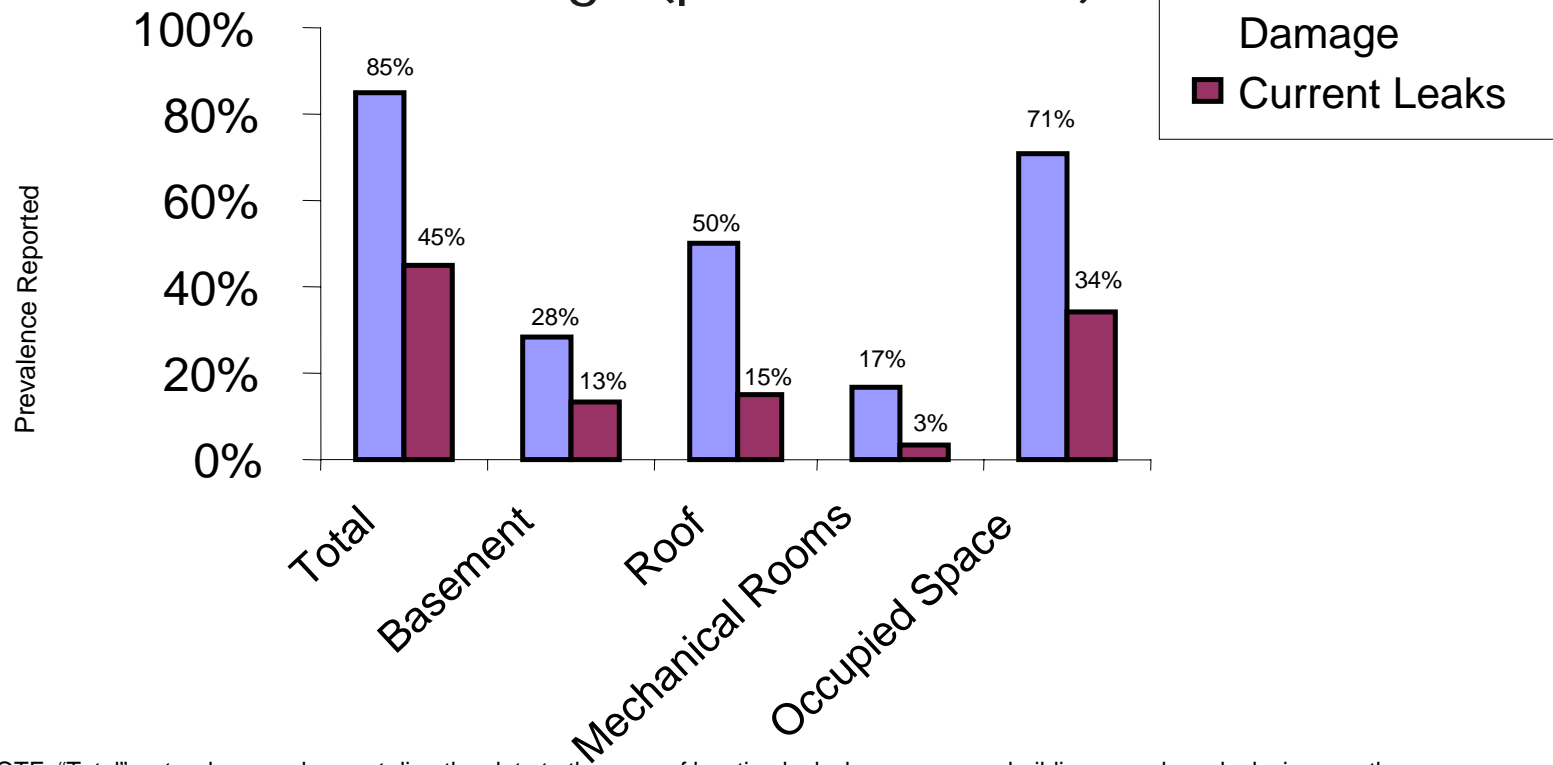
What Do We Know About Indoor Air Quality?

Potential Indoor Pollutant Sources: Office Renovations



What Do We Know About Indoor Air Quality?

Water Damage & Current Leaks in BASE Office Buildings (potential mold)



NOTE: "Total" water damage does not directly relate to the sum of location leaks because some buildings may have leaks in more than one location

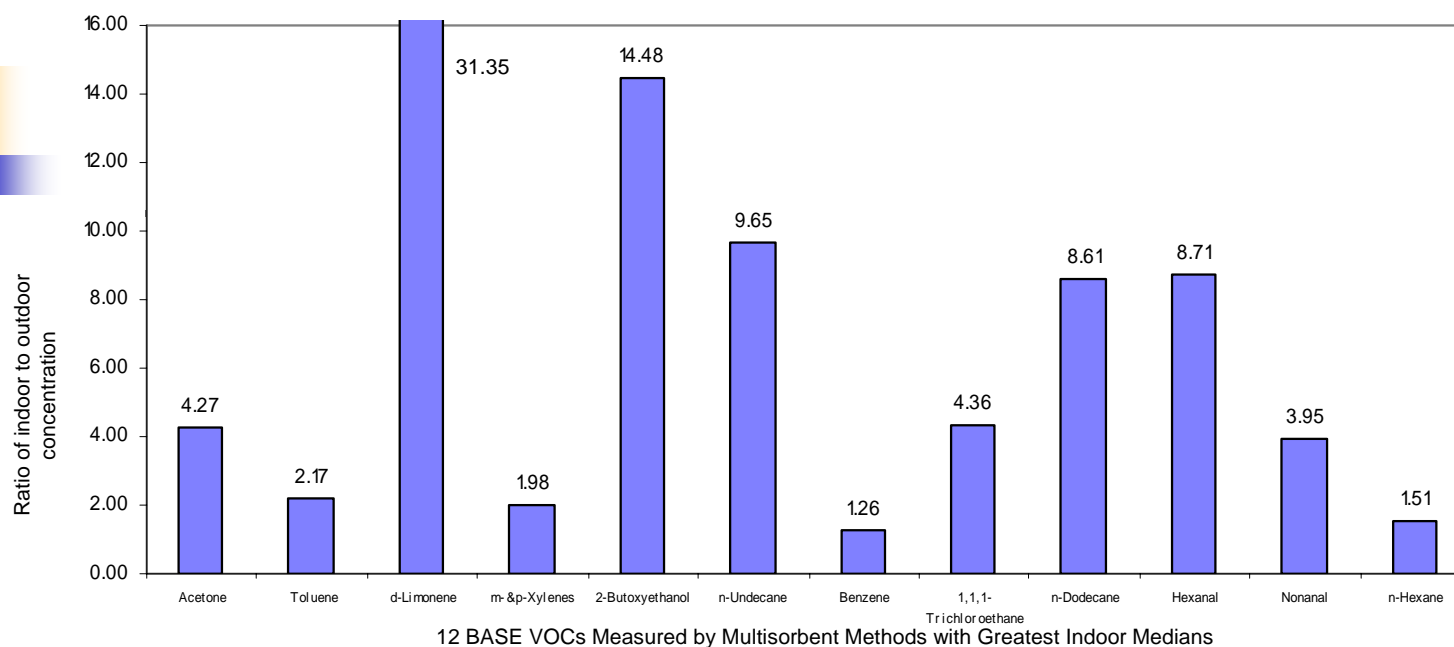
What Do We Know About Indoor Air Quality?



Building Operations and Maintenance

- HVAC system balancing
 - 44% of office buildings report not performing HVAC balancing
- Interior Pesticide Application
 - 39% of office buildings report interior pesticide application monthly or more than once a month

BASE Study – Median Indoor to Outdoor Concentration Ratios



	Acetone	Toluene	d-Limonene	m- & p-Xylenes	2-Butoxy ethanol	n-Undecane	Benzene	1,1,1-Trichloroethane	n-Dodecane	Hexanal	Nonanal	n-Hexane
geometric mean	4.1	2.8	26.4	2.6	12.6	10.8	1.3	5.5	9.8	7.7	4.0	1.7
10th percentile	1.5	1.2	5.8	0.9	2.6	3.1	0.7	1.8	3.6	3.0	1.6	0.6
median	4.3	2.2	31.3	2.0	14.5	9.6	1.3	4.4	8.6	8.7	4.0	1.5
90th percentile	11.2	8.5	82.6	8.9	56.4	55.8	2.4	18.5	33.0	19.0	11.5	4.2



What Do We Know About Indoor Air Quality?

Productivity and Student Performance

- Many studies relate dampness & mold to respiratory health, a leading cause of school & work absences
- Several studies relate high ventilation rates & low pollutant concentrations to improved health & productivity
- Other associations with productivity are also emerging (e.g., cleaning frequency, surface dust, housekeeping)
- See www.IHPcentral.org for a searchable bibliography on IAQ, health and productivity)



What Do We Know About Indoor Air Quality?

Productivity and Student Performance

- Danish Controlled Field Study (2000)
 - Three offices in two countries
 - IAQ Controls: Large changes in ventilation or the introduction of a hidden 20-yr old carpet
 - Perception of IAQ and performance on text, typing, proof-reading & addition all improved with better IAQ (2-6 % range)
 - Creative thinking improved with ventilation



What Are We Doing About Indoor Air Quality?

Research Planning

- Initiated by OAR-ORIA but strong collaboration with other EPA offices, especially ORD
- Intended to capture indoor environments research needs
- Hope to provide input and establish focus for indoor environmental research
 - Not exclusive to EPA, nor to governmental agencies
- Developed research planning document, Program Needs for Indoor Environments Research (PNIER)
 - Not prioritized; not a strategy



What Are We Doing About Indoor Air Quality?

PNIER Topics

- Pollutants, Sources and Health Effects
 - Chemicals (including Indoor Air Toxics)
 - Biological Contaminants
 - Sensitization, Allergy and Irritation Health Effects
 - Particulate Matter
- Human Performance
- IAQ Measures and Indices
- Building Design and Operation
- Homeland Security
- Product and Technology Verification



What Are We Doing About Indoor Air Quality?

- EPA's indoor environment programs are primarily voluntary program and need compelling evidence to succeed
- Many knowledge gaps exist, however, in many cases we know enough to develop and operate effective programs to mitigate poor indoor air quality
 - Radon testing and mitigation program
 - Smoke-free Homes Campaign
 - IAQ Tools for Schools & Design Tools for Schools
 - I-BEAM (office buildings)
 - Asthma
- See www.epa.gov/iaq